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Analysis of academic attitudes and existing processes to inform the design of teaching and learning material repositories

A user-centred approach

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ABSTRACT The last couple of years have brought a rise in the number of institutional repositories throughout the world and within UK Higher Education institutions, with the majority of these repositories being devoted to research output. Repositories containing teaching and learning material are less common and the workflows and business processes surrounding these types of repositories were unclear. The user motivations to contributing to and downloading from repositories were also unknown. This article reports on two studies: a wide-scale survey carried out with HE staff to identify barriers and incentives to contributing to teaching material repositories; and interviews carried out as part of a workflow study at Loughborough University, to identify existing practice in the creation and sharing of teaching material. Confusion is reported with regard to the difference between a Virtual Learning Environment (VLE) and a repository. However, many different purposes of a teaching and learning material repository are highlighted. This article discusses how repositories could successfully interoperate with other institutional applications and highlights the benefits of teaching material repositories to the user, through scenarios. Recommendations relating to the key aspects of the design and implementation of a repository service are outlined.

KEYWORDS: *business processes, e-learning, HE, Higher Education, institutional repository, repository, repository workflows*

Introduction and background

Preamble

Our objective was to uncover potential users' attitudes towards sharing teaching and learning materials within a digital repository. The results of our investigations informed the design of a demonstrator institutional teaching and learning material repository to provide academics with new ways of sharing resources and expertise. The intention was not to replicate a Virtual Learning Environment (VLE) which is the most commonly used mechanism for sharing teaching material with students, but improve access to resources for different staff across the education sector.

Background to repositories

Repositories maintained by Higher and Further Education institutions in the United Kingdom (UK), i.e. Institutional Repositories, usually comprise research output, sometimes with teaching and learning material. Such repositories are usually Open Access (OA), rather than access being limited or authenticated to particular groups, such as a VLE. Hayes (2005) describes a digital repository as one where 'digital content, assets, are stored and can be searched and retrieved for later use'. Research output repositories have been the most popular type to date, with many UK Higher Education (HE) institutions now having, or considering deploying, such a system. According to the Registry of Open Access Repositories (<http://archives.eprints.org/>), there were 102 HE Institutional Repositories in the UK in June 2007, with over 85 (89%) of these being devoted to research output. There has been little research hitherto into repositories of other data types, such as teaching material and learning objects. At present, teaching material repositories exist on a national or international scale, most notably Multimedia Resource and Online Teaching (MERLOT) (<http://www.merlot.org/>), an international repository, and Jorum (<http://www.jorum.ac.uk>), a UK national repository funded by the Joint Information Systems Committee (JISC). McMartin (2004) recognizes that the sustainability of the MERLOT service is due to 'its commitment to creating and supporting services that support the needs of its users as expressed by the users'. MERLOT is one of the largest teaching material repositories in the world; this is reflected by the 47,000 registered members and over 16,000 resources. In the UK, few institutions currently have a separate OA repository to hold teaching materials. Jones et al.'s seminal book (2006) on Institutional Repositories primarily focuses on those related to research output, and shows how new and undeveloped the area of institutional repositories of teaching materials is. One distinction made between the two material types is that 'research materials

are likely to be quite widely read by other members of a disciplinary community across the world' whereas 'the value of learning objects [and other teaching material types] lies in their capacity to be re-used' (Jones et al., 2006).

Repository workflows and business processes

Hollingsworth (1995) describes a workflow as being, 'concerned with the automation of procedures where documents, information or tasks are passed between participants according to a defined set of rules to achieve, or contribute to, an overall business goal'. Our business goal is to design and develop a demonstrator teaching and learning material repository which provides many benefits to individuals and the institution. Such benefits could be seen as enhanced re-use and management of institutional resources and improved ways of communicating and sharing of expertise. One of the organizational viewpoints on the Digital Repositories Road Map (Heery and Powell, 2006: 11), which presents a vision for 2010, is to 'Carry out analysis of existing business processes, workflows and dataflows; identify opportunities for innovative inter-working between repositories and between repositories and other applications'. Jones et al. (2006: 110) believe that you could 'try and tailor the working practices of the repository to the ones that already exist in real life'. Casey et al. (2006: 710) identify that 'in order to understand how to successfully implement e-learning in our organizations we need to understand how they work in the first place in order to change them effectively'. Jones et al. (2006: 85) believe, in relation to workflows, that 'understanding how they are constructed then allows us to present some examples for different purposes that may be of use in an institutional repository'. We aim to identify the rationale behind a teaching material repository and illustrate a variety of purposes and uses, through the use of scenarios.

Other projects have reviewed existing workflow practices of repositories, although, each in a different context. The RepoMMan (2005) project's remit was to 'understand the processes that a researcher undertakes between having an idea for a piece of work and seeing it appear in print' (Green, 2005: 3). We are also interested any systems, technology and people involved in such processes from the perspective of teachers. The Community Dimensions of Learning Object Repositories (CD-LOR) Project (2005) discovered a number of enablers (ease of use and adequate user support) and barriers (low quality of resources and lack of copyright information) to using Learning Objects (LOs) (Margaryan, 2006). We have studied copyright in greater detail, specifically, authors' attitudes towards the rights protection of their research and teaching materials (Gadd et al., 2007).

Learning – ‘a journey of the self’

Hedgebeth (2007) recognizes the importance of collaboration and the transfer of expertise through knowledge sharing technologies (such as repositories, wikis and blogs) within organizations. Wenger (2005) highlighted an individualistic view to sharing resources and expertise and believes that ‘enabling learning is not merely the transmission of information and skills, but an invitation to a journey of the self’, and that learning is ‘a social journey’. Like Wenger, McNaught (2003: 207) identifies the importance of individuals, by arguing that ‘we need to find ways where individuals can feel that, within a collaborative project, they are establishing their own personal reputations whilst also having access to and contributing to the pool of reputation and combined intellectual input of others’.

In our research we have explored a number of questions. How would academics use the repository to collaborate with others, and what would the barriers and incentives for using a repository be? What are the existing user processes associated with creating and sharing teaching material relating to communication, support and technology? How will Institutional Repositories inter-work with other institutional systems? Finally, as there is little research in this area, what do we recommend from our research to others? This article reports on our findings.

Methodology

Our inter-disciplinary approach

The Rights and Rewards in Blended Institutional Repositories project (2005) was funded by JISC under the Digital Repositories Programme (JISC DRP, 2005). This research and development project focuses on the idea of a ‘blended’ repository of both research and teaching material, and we tested our findings on a demonstrator repository of this kind. However, our primary focus was on teaching materials. We had a trio of project partners, all based at Loughborough University: the Department of Information Science, the engineering Centre for Excellence in Teaching and Learning (engCETL) and the University Library. We adopted an inter-disciplinary approach to our research as Campbell (2005) advocates.

User-centred design

By adopting a user-centred design approach rather than one which was led by technology, we hoped to make the user’s needs a priority and to provide a complete service rather than a number of IT systems working in isolation. Using this method, the service should evolve around the

contributors' needs and preferences, and the features and functionality of chosen IT systems will be dependent on these. This approach aligned with the Digital Repositories Road Map, which advocates the need to 'explore user requirements in greater detail' (Heery and Powell, 2006: 11). We identified contributor requirements and show how their existing needs might best be fulfilled within a repository environment. This will be of benefit to those in the HE community who are in the process of establishing a teaching and learning repository in their own institution.

The survey – a broader picture

From September to November, 2005, we carried out a motivational survey to identify the barriers and incentives associated with teaching and learning material repositories (Bates et al., 2007). The survey was delivered online. A total of 430 valid responses were recorded from individuals within 88 distinct Higher Education Institutions (HEIs). The survey was widely advertised by way of 755 email communications, which were sent to 98 UK HEIs. Fifty-six emails were sent to individuals within Higher Education Academies (HEAs), and as a result, our survey was posted on many HEA news bulletins. The response rate was impossible to calculate as the survey was delivered online.

Questions were split into six sections. Section A collected demographic information. Sections B, C and D looked into past, current and future use of repositories, respectively. Section E focused on the rights associated with materials placed within repositories and Section F captured any other comments.

The interviews – an institutional view

In 2006, ten interviews were carried out with academics based in a variety of departments throughout the three University Faculties at Loughborough; Engineering (one), Science (three) and Social Science and Humanities (six). The interview participants were selected based upon the amount and variety of material that they had uploaded onto the University's (VLE). The purpose of the interviews was to capture information relating to existing business practice within our institution. Information captured from the interviews was used to help us to envisage the people and systems involved with relevant existing business practice.

The format for each interview was to provide an introduction to the project and the study. Each participant was then asked the same questions, with the average time of each interview being 45 minutes. The focus of the interviews was on the creation and deposit of materials rather than its retrieval. Of the 35 invitation emails that were sent out, just over one-quarter (26.8%) agreed to be interviewed.

The questions were split into six different sections. Section A collected information relating to the teaching material that is produced by academics. Section B collected information on the processes related to the re-use of other people's teaching materials. Section C focused on the technical systems that academics use to share their teaching materials with students and beyond. Section D focused on identifying stakeholders involved within the workflow of creating, modifying, sharing and storing teaching materials. In Section E, participants were asked if they had contributed research items to Loughborough University's Institutional Repository. Participants were finally asked if they wished to make any additional comments.

Data analysis and findings

The survey was analysed by the Library and Information Statistics Unit (LISU) at Loughborough University. The interviews were written up by the project team and the write-up was then e-mailed to the interviewee, who checked for misinterpretations and mistakes. The data was then analysed, section by section.

An overview of the survey findings

A total of 430 valid responses were recorded. The majority of participants worked within a UK University, with 221 participants (51.3%) situated with UK pre-92 Universities and 143 respondents (33.2%) based within UK post-92 universities. 230 respondents (53.5%) shared teaching materials within a Virtual Learning Environment (VLE). A total of 169 (38.8%) respondents had contributed to a repository before.

Respondents identified two distinct types of content which could be deposited or found within a teaching material repository. First there were those items that could be embedded into teaching, such as diagrams or text that can be re-used. Secondly, there were items that inform the teaching and learning process, such as teaching exemplars, how-to-guides and FAQs. This shows differences amongst participants as to the purpose of a teaching material repository and that there are many uses for a repository of this kind.

Survey analysis: what would the barriers and incentives for using a repository be?

Over three-quarters of respondents (347, 80.7%) would be much more likely or likely to contribute to a repository in the future if support was freely and easily available. Just under three-quarters (310, 72.1%) of respondents would do so, to preserve materials. A total of 220 respondents who had contributed to a repository did so, to 'improve my teaching'

(51.2%). Just under one-half (207, 48.2%) were motivated to use a repository to 'improve student motivation'. Over two-thirds (291, 67.7%) of participants were 'much more likely' or 'likely' to contribute to a repository in the future if the repository was 'connected to research as well as teaching'. Over three-quarters (324, 75.4%) of respondents would definitely or consider contributing to a repository for the 'satisfaction of contributing'. Just under two-thirds (271, 63.2%) would definitely or consider contributing for a period of secondment for professional development.

In terms of identified barriers, over one-third (171, 39.8%) of respondents who had used a repository in the past stated that it was not clear how materials could be re-used or modified within the copyright guidelines. Nearly half (185, 43.0%) of respondents who had not contributed to repositories, had not done so because they were not aware of any repositories. Just under one-quarter (119 or 27.6%) of respondents who had not contributed to repositories, had not done so because of time pressures. Over one-quarter (115, 26.9%) of participants who had used a repository in the past disagreed that 'it did not take long to find what I was looking for'. Of those who had downloaded material in the past, just over one-third (158, 36.8%) of respondents 'strongly agreed' or 'agreed' that 'details of the author and copyright information was easy to locate'.

Interviews – What are the existing user processes associated with creating and sharing teaching material relating to communication, support and technology?

Table 1 illustrates the identified generic stages involved in the workflows studied with corresponding information about the specific task investigated and the interrelationships between people and IT systems involved. From the interviews we have identified five different user stages in the lifecycle of teaching material and some common tasks that academics carry out.

Our interviews showed, unsurprisingly, that all participants made their teaching materials available to students via the University VLE. One participant also made their materials available on a website maintained by themselves and hosted by the University. The majority of participants (eight out of ten) made these materials available without the help of others, one was assisted by a secretary and one was supported by their Faculty's Online Learning Development Officer. However, not all interviewees shared the same views in relation to the creation of their teaching material, nor did they carry out this task the same way. Two out of ten participants enjoyed creating material on their own and keeping to their own ways of doing things. Six out of ten participants would like to enhance their material and use different technologies that interact with students better but do not

Table 1 Support, communication and technology at identified user stages

<i>User stage</i>	<i>User task</i>	<i>People involved with user communication and interaction</i>	<i>People who provide user support</i>	<i>User systems/technology</i>
Idea/need for material	Formulating ideas	Internal peers, external peers, external examiners	Professional development (assessments), learning and teaching co-ordinator	Subject general or specific information services and systems, e.g. Higher Education Academy (HEA) sites
	Search for materials		Library staff	Subject general or specific information services and systems, e.g. Google
	Create plan either on paper or in own head	Internal peers		
Creating	Create material		Online Learning Development Officers (OLDOs), Professional Development	Computer aided assessment technology
	Adapt to 'house' style e.g. add logo(s)		Technical author/tutor	Email
	Create in multiple file formats		OLDOs, technical author/tutor	Email

Sharing	Uploading onto VLE	Secretary/admin staff	Email
Editing or updating	Obtain a copy of material	Secretary/admin staff	Email, VLE
	Revise materials (either on a major or minor basis)		Subject general or specific information services and systems, e.g. Cambridge Scientific Abstracts
	Upload the revised material	Secretary/admin staff	VLE
Deletion or archiving	Delete from VLE	Secretary/admin staff	External hard drive, network backup/storage
	Archive to hard disk or repository		

believe they have the skills or time to do so. Two out of ten participants enjoyed creating interactive materials, using a variety of technologies and systems to do so.

Figure 1 allows us to distil the different levels of communication, support and technology that are needed in each of the identified stages of the teaching material workflow. They represent the general picture of these three elements from the interviews. Interaction with other peers is most likely to occur at the idea/need for material and editing/updating material stages. Support is predominantly sought or needed at the deletion/archiving stages. Systems and technology are used at the ideas and creating stages and equally at the sharing and deletion/archiving stages.

Our results showed that formal practices of communication and sharing are minimal compared to more informal methods. However, one participant stated that they have meetings in their department to discuss teaching as well as having informal discussions with others. This is not the case for the majority of academics, who typically rely on more casual ways of communicating and sharing. One participant mentioned that they take every

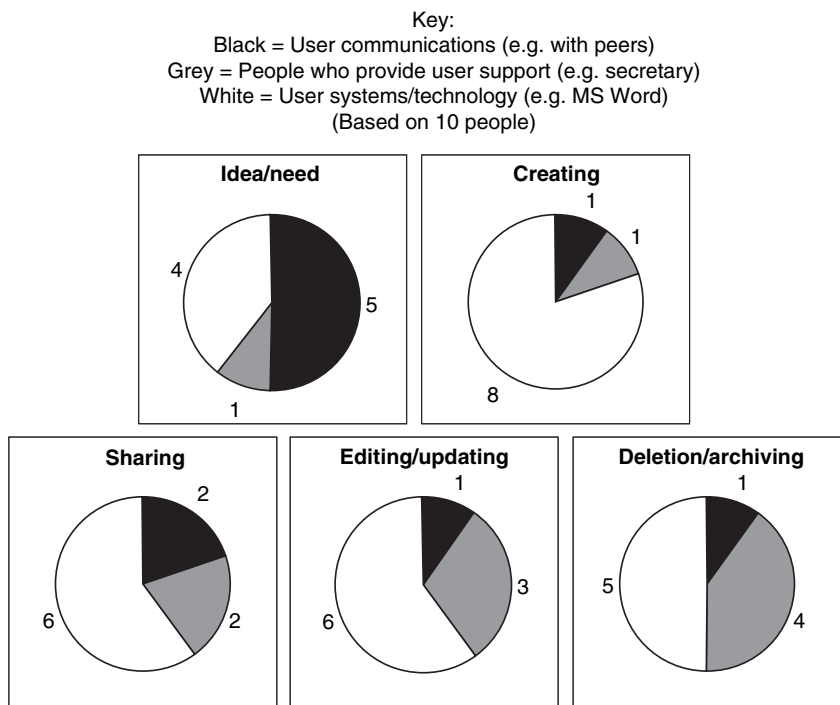


Figure 1 Proportion of user support, communication and technology relating to different teaching material processes

opportunity to share their resources with others and have created an ‘informal web’ of people who share ideas. There were many people that the interviewees communicate with informally, including IT specialists, learning technologists, departmental peers and professional development personnel. Informal communication was important and they would like more opportunities to share informally.

Table 2 shows how support, technology or communication (identified from the interviews) could potentially help to overcome the barriers and provide incentives (identified by the survey).

Discussion

How would an institutional teaching repository inter-work with institutional systems?

Figure 2 provides an overview of systems identified at Loughborough, which aligns with Heery and Powell’s (2006: 11) road map recommendation. A teaching and learning material repository has been added to show how it could sit alongside existing systems. Instead of a single repository system, this would function as a repository service. Operating distributed systems that interoperate can help to ensure sustainability because the removal of one service does not affect the successful operation of the remaining services.

One might ask, why is a repository needed if institutional systems already exist that hold teaching and research material? A large range of content is identified in Figure 2, such as research outputs (Dspace), images (Imagebank) and a variety of textual and teaching content on the VLE. A teaching and learning repository could hold material such as how-to guides and teaching exemplars as identified by our survey. Scenario one highlights the benefits of a repository that interoperates with existing institutional systems.

Scenario one: the benefit of repositories inter-working with existing applications

A lecturer needs some diagrams to complement a set of case studies they have created for their students. They visit a learning and teaching repository which provides a search mechanism that searches across the institution’s VLE, image store and the repository itself. In the past, they visited a number of subject-general and subject-specific services to find new resources to enrich their case studies, including various internal and external websites and databases. Whilst searching external sources may still be valuable, searching internal sources is made easier and the search retrieves a range of resources, which are of use. In return, the lecturer deposits their

Table 2 Examples for overcoming barriers and providing incentives

<i>Identified barriers (survey)</i>	<i>Interventions for potential user support, communication and technology (interviews)</i>	<i>Example solution(s)</i>
Unclear copyright guidelines	User support	Design a suitable copyright mechanism and identify support to assist users.
Time pressures/ taking too much time	User support, user technology	Identify ways of making the system easy to use. Also, promote the personal benefits to potential users.
Not aware of any repositories	User support, user communications	Promote the repository to potential users and support staff.
<i>Identified incentives (survey)</i>		
Support freely and easily available	User support	Identify and establish an adequate support network.
Preserve materials	User technology	Provide for adequate storage and preservation of digital resources.
Improve my teaching	User technology, user communications	Use Web 2.0 technology to enhance communication, resulting in improved expertise and teaching.
Improve student motivation	User technology	Allow students to access some or all resources.
Connected to research and teaching	User technology	Bring research and teaching systems together. Use information from these existing systems.
Satisfaction of contributing	User communication	Attempt to overcome cultural attitudes. Promote altruistic reasons for sharing to different users.

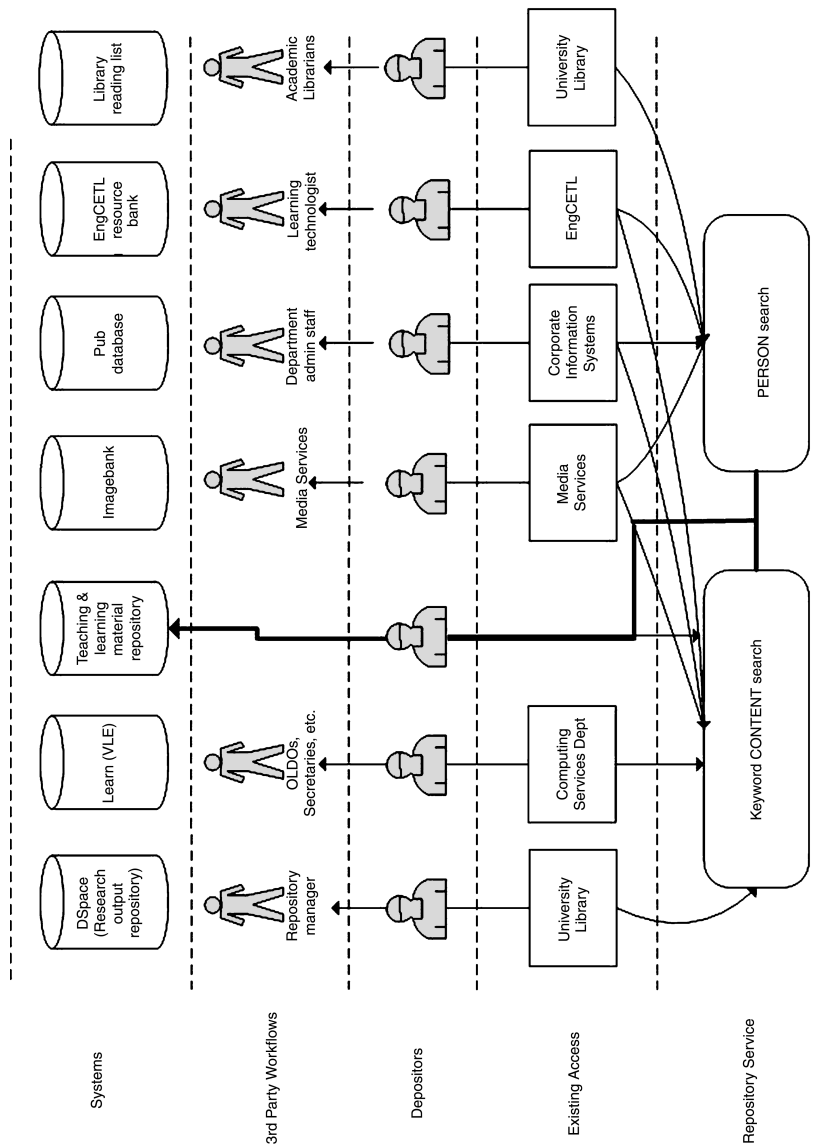


Figure 2 An overview of how a repository service may bring systems and people together

case studies and other materials into the teaching and learning repository to share a variety of materials with internal colleagues.

Understanding existing business processes and user requirements – user support

The project's interviews showed that support was most needed when sharing materials with others. The survey highlighted that time pressures presented contributors with considerable barriers to sharing materials. Adequate support being freely and easily available could alleviate this barrier. By analyzing the 'real' processes and identifying the support available we can describe how support could enable contribution. Scenario two highlights the benefit of user support in facilitating contribution to a repository of teaching materials.

Scenario two: user support – benefiting repositories through the removal of barriers

An academic wants to archive some diagrams that may of use to other members of staff in the future. They discover that their institution has a teaching repository. They contact the repository manager who helps them to deposit material by making sure that the files are in a format for preserving and depositing. The repository system automatically emails the academic with a permanent link to the diagrams, so that they can always refer to them in the same location for future reference. Without the help from the institutional support network this deposit may not have been possible.

Understanding existing business processes – user communications

While a VLE directly benefits students, a repository of teaching and learning materials provides many new opportunities for sharing with colleagues across disciplines, internally and externally. Communication usually occurred at the initial user stage when they were gathering ideas. Scenario three highlights the benefit of a teaching and learning material repository, as a method of collaborating and sharing informally.

Scenario three: the benefit of repositories – enhancing user communications

An academic currently delivers their teaching material on the VLE for their students. They are introduced to a teaching and learning repository that has just been launched within their institution – by support staff. The academic

has a variety of citation guides that may be of benefit to other staff, both internally and externally but they have hitherto not had any mechanism to enable sharing of them. If they upload the material to a VLE, not all of these peers will be able to access the material, owing to password restriction and access rights. The academic, therefore, deposits their materials to the Institutional teaching material repository and discovers a colleague from another faculty who also has some guides related to citations. Without the existence of a repository this may have not been possible.

Understanding existing business processes – user technology

Many of the incentives for contributing to a repository were personal ones, which support Wenger and MacNaught's views of individuals being at the forefront of the learning process. The interviews suggest a need for more informal ways of collaborating and sharing materials. The growth of social networking sites such as Myspace (www.myspace.com), Flickr (www.flickr.com) (Images) and YouTube (www.youtube.com) (Videos) shows, at present, how popular informal sharing is. These are predominantly structured around the needs of the individual. This is untrue of VLEs, which are mostly structured around a course or module. If a repository were to be more like a social networking site, rather than a VLE, it would require user participation. Web 2.0 technologies provide an 'architecture of participation' (O'Reilly, 2004) that supports the exploration and discovery of various content types and encourages self promotion. The final scenario highlights how new web 2.0 technologies can be used to allow the informal sharing of materials, whilst supporting a 'journey of the self' (Wenger, 2005).

Scenario four: the benefit of web 2.0: an informal repository route to 'a journey of the self'

A lecturer wants to find some information on digital photography. They use a teaching and learning material repository service that provides an informal way in which others can share material and expertise. They type 'digital photography' into the search box. The results are returned and the academic is provided with content to embed into teaching, items to inform the teaching and learning process and a list of people that are interested in digital photography. A couple of blog postings are also identified. Web 2.0 technology also allows them to link their blog to others blogs through the use of RSS and are a good way of capturing and transferring thoughts and expertise. Information related to people provides a bridge to facilitate communication between the academic and other users.

Conclusion and recommendations

Our study aimed to highlight the workflows of potential content contributors in the creation and sharing of their teaching materials and to highlight the many benefits of a teaching material repository. Owing to the lack of research into teaching material repositories there was little to inform the questions that we asked in both studies. There was much confusion as to what a repository was, and participants may also have been confused as to what they wanted from a repository. What emerged, however, was a clear opportunity for alternative materials that could be put into a repository, not necessarily suitable for a VLE or other institutional system(s). However, how national and institutional repositories of learning materials fit together, including social mechanisms for sharing these resources, has yet to be explored. The following recommendations have been distilled from the findings and discussion and can be used by others to help evaluate the success of Institutional Repository services in relation to communication, support and IT matters. Recommendations relating to repository design and development have also been made. These recommendations are not limited to a teaching and learning repository, but may also be applicable to other repository types. Recommendations related to communication and support:

1. Support and expertise must be easily and freely available to contributors to facilitate contribution to a repository. This support must also be available for the personnel supporting and maintaining the repository service.
2. Contributors (that is, academics) prefer informal communication and sharing methods and therefore, the repository service should provide ways in which materials and expertise can be shared informally.
3. The repository needs to be promoted strongly to different groups, for example, new or probationary lecturers, to help foster a culture of sharing and help to build communities of practice within the institution.

Recommendations related to Information Technology and repository systems:

1. Identify existing institutional systems to see how a repository would fit in with such systems (see Figure 2, for example).
2. The repository service needs to help automate common administrative tasks, such as archiving of old material, and provide solutions to keeping users informed of updates and information regarding the use of the material they have contributed. The system should reduce the need for human assistance, wherever possible.
3. Technology should be used so that material is structured around the individuals.

Recommendations related to the process of repository design and development:

1. A user-centred approach to the design and development of a technology related service, such as a repository, helps to highlight the functional and non-functional requirements of such a system, with the emphasis on user requirements rather than what the technology can provide.
 2. Carrying out surveys and interviews with the potential users of the system has helped to create buy-in from future users and may be crucial in encouraging the 'take-up' of the repository.
 3. From the survey and interviews, many see the repository as a similar system to a VLE, and therefore the unique qualities of the repository must be publicized.
 4. Stakeholders such as support staff and contributors should be contacted during the development of the repository, as they will help to build the momentum of support that is needed to help use and populate the repository with content in the early phase of its provision.
- Recommendations for further research:

1. A study of contributors' perceptions of the usefulness of repositories versus actual use would be of benefit. This could be presented using scenarios like the ones in this article and could analyse the use of particular items and the usefulness of comments and feedback received.
2. A study into how a repository benefits learning by comparing the perspectives of contributors and content consumers could provide answers to the following questions. Were resources easy to locate and access? Were they useful? How were resources repurposed in teaching? Did collaboration across institutional departments or with students occur?
3. A study into how students interact and can use repositories in conjunction with a VLE would extend our initial investigations into staff-to-staff sharing via repositories.

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